

# MALAYSIA

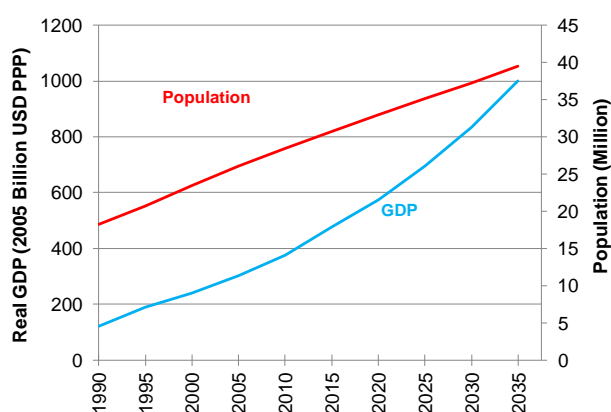
- Malaysia's primary energy supply is projected to grow at 1.7% a year, to reach 103 Mtoe in 2035. The growth is driven mainly by demand for gas in the electricity generation sector and demand for oil in the transport sector.
- The oil and gas sectors have long been significant contributors to Malaysia's GDP and energy security, but this is likely to change due to rising domestic demand and maturing reserves. To meet this challenge, Malaysia will sustain production by rejuvenating existing fields and intensifying exploration activities while enhancing downstream growth and leveraging on its strategic location to become a regional hub for oilfield services.
- Electricity demand is expected to increase significantly from 96.3 TWb in 2009 to 206 TWb in 2035. To better manage this increasing demand, Malaysia aims to encourage efficient use of energy through initiatives like the Malaysia Green Labeling Program and Green Building Index, and to diversify its energy sources by building up solar capacity and tapping its vast hydroelectricity potential.

## ECONOMY

Malaysia is located in South-East Asia. Its territory covers an area of 330 803 square kilometres, spread across the southern part of the Malay Peninsula and the Sabah and Sarawak states on the island of Borneo. Malaysia's neighbours include Indonesia, Singapore, Thailand and Brunei Darussalam. Malaysia currently shares electricity interconnections with both Thailand and Singapore. Gas pipelines link Malaysia to Thailand, Singapore and Indonesia.

In 2009, Malaysia's total population was estimated to be about 28.3 million, with over 70% living in urban areas (DOS, 2011). Since its interior terrain is mostly forest-covered mountains, the Malaysian population is largely concentrated on the coastal plains. Malaysia's highest population densities are found in the peninsula cities of Kuala Lumpur, Penang and Putrajaya (DOS, 2011). The total population is projected to grow at an average annual rate of 1.3% over the outlook period, reaching just below 40 million by 2035.

**Figure MAS1: GDP and Population**



Sources: Global Insight (2012) and APERC Analysis (2012)

Malaysia's GDP per capita in 2009 was estimated to be about USD 12 600 (in 2005 USD PPP), the third highest among the ASEAN economies. Based on current trends, Malaysia's annual GDP growth is predicted to be 4% for the next 25 years. Poverty has mostly been eradicated, and there is generally good access to water, electricity and telecommunications facilities.

Malaysia is an upper-middle-income developing economy with aspirations to achieve developed status by the year 2020. The Vision 2020 objective was first announced in 1991; since then several initiatives and programs have been put into place to drive economic growth. The latest, the Economic Transformation Programme (ETP), was launched in 2010 and is the most comprehensive initiative yet, incorporating active participation from the private sector and business community. Under the ETP, 131 Entry Point Projects (EPPs) were identified and categorized under 12 National Key Areas (NKEA) to provide focused economic growth. The 131 EPPs are high-impact projects, matched with specific ideas and actions, and are prioritized in government planning and fund allocation. By the end of 2011, 83% of the EPPs had either begun work or were currently in operation (PEMANDU, 2012). These accelerated EPPs are expected to stimulate economic growth, and this will be matched by corresponding growth in energy demand.

Manufacturing is a major contributor to the Malaysian economy, particularly the electrical and electronics, chemical products, and petroleum products manufacturing industries. Natural gas and electricity are the main energy sources used, while coal is used mostly by the cement, and iron and steel manufacturing industries.

Mining and agriculture are two other important economic activities; in 2009, each sector contributed

7.7% of the Malaysian GDP (MOF, 2011). Tin, oil and gas are the major natural resources of export significance in the mining sector. Other minerals mined in Malaysia include iron ore, bauxite, coal, ilmenite and gold. Overall, mining will continue to play a small but vital role in the economy.

The agricultural sector, which includes fisheries and forestry, has been identified as one of the NKEAs under the ETP and is currently undergoing rapid modernization and commercialization. As a result, the sector is expected to experience consistent economic growth in coming years. Some of these measures are already paying off: Malaysia is now one of the leading producers of palm oil worldwide and through concerted research initiatives, new applications of palm oil in biofuel production and biomass power generation have been successfully implemented.

In terms of passenger and freight volumes, road transport is the leading transportation mode in Malaysia (Ong et al., 2012). Malaysia has extensive road networks, totalling 157 167 km at the end of 2011, of which 81% are paved (EPU, 2012, p. 30). There are a total of 28 high-speed divided highways in the economy with a total length of 2137 km (LLM, 2012).

In 2009, there were about 19 million registered vehicles in Malaysia, and this is increasing at an average annual growth rate of 6.4% (RTD, 2010). Malaysian manufactured cars from Perodua and Proton currently dominate the economy's automobile market, although decreasing import taxes mean imported cars from Japan and Europe are gaining a greater share of the market each year. There is a mixture of new and rebuilt imported cars available in Malaysia, based on the economy's healthy rebuilt vehicle industry—there are eight rebuilt car manufacturers and nine rebuilt motorcycle manufacturers. Given the ease of obtaining car loans and subsidized fuel prices, car ownership is high among the population. According to the Malaysian Automotive Industry, based on historical trends it is unlikely that car ownership will reach saturation level in the near future, and car sales are expected to continue to grow at a moderate rate (MAI, 2011).

Rail transport, monorail and light rail transit systems also play significant roles in the land transport system, especially in Kuala Lumpur, Malaysia's capital city. Malaysia also has excellent marine port and airport infrastructure in key locations, which allows Malaysia to take advantage of its strategic position in the middle of the Trans-Asian route. In its Tenth Malaysian Plan, which covers 2011–2015, Malaysia has budgeted about

MYR 13 billion (about USD 4.3 billion) to upgrade and enhance transportation access and connectivity (EPU, 2011). Some of the planned projects are to build road and rail links to major ports and airports, build electrified double-track rail lines, deepen port channels, upgrade marine ports and expand airport capacity.

Malaysia's equatorial climate has year-round average temperatures of 20–35°C and relative humidity of 80–90%; the timing of the rainy season on the peninsula coast varies. The tropical climate requires year-round space cooling in Malaysian buildings. On average, space cooling accounts for nearly 40% of the total building energy requirement. Malaysia is relatively safe from extreme natural disasters like earthquakes and hurricanes, although mild flooding does occur in certain regions, causing damage to properties but generally no loss of life.

## **ENERGY RESOURCES AND INFRASTRUCTURE**

Malaysia is blessed with a variety of primary energy resources, including oil, natural gas, coal and renewable energy. According to the Malaysian Economic Planning Unit, as of 1 January 2011, there is an estimated 2.5 trillion cubic metres (89.9 trillion cubic feet) of natural gas and 5.9 billion barrels of oil reserves available, that will last 39 and 25 years respectively (EPU, 2011). The National Depletion Policy of 1980 aims to safeguard depleting reserves by restricting the production of hydrocarbons to 3% of 'oil initially in place'. This effectively limits the production of crude oil to 650 000 barrels per day and natural gas in Peninsular Malaysia to 2000 million standard cubic feet (56.6 million cubic metres) per day (KeTTHa, 2009). The economy also has about 1.9 billion tonnes of coal resources that are largely underexploited (Tse, 2011).

The majority of Malaysia's oil production comes from offshore fields in the Malay basin in the west, as well as the Sabah and Sarawak basins in the east. Malaysia's oil quality is generally high, but production has been declining in the past decade. To extend the reserves' lifetime, oil exploration activities are being expanded into deepwater—an activity which is significantly more challenging, both economically and technically. The Kikeh project was the first successfully developed deepwater oilfield in Malaysia, with two more deepwater fields under development in Gumusut/Kakap and Malikai (Rasheed Khan and Murzali, 2008).

There are five oil refineries in Malaysia with a combined capacity of 492 000 barrels per day—used for both domestic consumption and export (EC,

2012, p. 31). A sixth refinery will be added by 2014 under the Refinery and Petrochemical Integrated Development (RAPID) project in Pengerang, Johor. The refinery will have a capacity of 300 000 barrels per day and will supply feedstock for RAPID's petrochemical complex as well as produce gasoline and diesel that meet European specifications (Petronas, 2012b).

Like its oil reserves, the economy's natural gas reserves lie offshore of Peninsular Malaysia's east coast, Sabah and Sarawak. The three most active areas are the Malaysia–Thailand Joint Development Area (JDA), the SK309/SK311 area in offshore Sarawak, and Bintang area near Terengganu.

Malaysia has two gas pipeline networks. The Peninsular Gas Utilisation (PGU) network now includes over 2500 km of pipelines linking most cities in Peninsular Malaysia and it has cross-border interconnections to Singapore and Songkhla, Thailand. The PGU pipeline system incorporates six gas-processing plants with a combined capacity of 56.6 million cubic metres (2060 million standard cubic feet) per day, producing methane, ethane, butane and condensate (Gas Malaysia, 2012). The system receives gas from offshore Peninsular Malaysia fields as well as imported gas from JDA, West Natuna and PM3 CAA fields. About half the PGU system gas is consumed by the power sector while the rest goes to non-power industries or is exported to Singapore (Maybank, 2012).

The second gas pipeline linking the states of Sabah and Sarawak is under construction and expected to be completed by 2013. The Sabah–Sarawak Gas Pipeline (SSGP) will be approximately 521 km in length, and will deliver natural gas from Kimanis in Sabah to an LNG facility in Bintulu, Sarawak (OBG, 2012).

The economy operates extensive LNG export facilities and produces 13% of world LNG exports. As of 2010, Japan remained the largest importer of Malaysia's LNG, followed by Korea and Chinese Taipei (MLNG, 2011). To meet the anticipated shortfall of gas in the Malay Peninsula, Malaysia constructed its first LNG Regasification Terminal (RGT) in Malacca, which was completed in mid-2012. Once fully operational, the terminal will have the capacity to process and store up to 3.8 million tonnes per annum of LNG. A second RGT is being planned for the Pengerang Integrated Petroleum Complex (PIPC) in Johor (OBG, 2012) and a third RGT in Lahad Datu, Sabah.

Bituminous and sub-bituminous coals make up the bulk of coal reserves in Malaysia. Although the coal resource in Malaysia is substantial, domestic coal

production has not been aggressively pursued because most of these coal deposits are far inland, where infrastructure is lacking and the extraction cost is high. Some locations, like the Maliau Basin in Sabah, have been designated as protected areas. Currently, coal mining is only conducted in Sarawak—production comes from the areas of Bintulu, Merit-Pila, Silantek and Tutoh. In Peninsular Malaysia, coal is used primarily for power generation, by the iron and steel industry, and by cement manufacturers. At present, coal is imported from Australia, Indonesia, South Africa and Viet Nam (Tse, 2011).

Renewable resources, especially hydropower and biomass, are in abundance in the economy. Malaysia's hydropower potential is assessed at 29 000 MW, mostly located in East Malaysia. In 2008, it was announced that several large hydroelectric projects will be developed under the Sarawak Corridor of Renewable Energy (SCORE); this will take over 20 years to develop and will generate a total of 20 000 MW when completed.

Small-scale generation from mini-hydro, biomass, solar and wind are already in place, totalling 773.6 MW. Of this figure, 15.3% is currently grid-connected while the rest is for self-generation in the industry sector. Over 90% is based on biomass power generation (EC, 2012). In 2011, the Malaysian Parliament approved a sophisticated system of feed-in tariffs that came into effect on 1 December 2011. This is expected to accelerate renewable energy development in the economy.

## ENERGY POLICIES

Malaysia's National Energy Policy was first formulated in 1979 by the Economic Planning Unit under the Prime Minister's Department. The policy consists of three principal energy objectives:

1. *The Supply Objective.* To ensure the provision of adequate, secure and cost-effective supply of energy.
2. *The Utilization Objective.* To promote efficient utilization of energy and to discourage wasteful and non-productive patterns of energy consumption.
3. *The Environmental Objective.* To minimize the negative impacts of energy production, transportation, conversion, utilization and consumption on the environment.

These three principle objectives are instrumental in the development of Malaysia's energy sector. Subsequent policies are designed to support these objectives and their implementation.

The National Depletion Policy was formulated in 1980 to prolong and preserve the economy's oil and gas resources by setting a limit on the annual production of oil and natural gas. A year later, the economy introduced the Four-Fuel Diversification Policy, with the aim of diversifying the energy mix used in electricity generation. The initial focus of this policy was to reduce the economy's dependence on oil as the principal energy source, and it aimed for the optimization of the energy mix of oil, gas, hydro and coal used in generation of electricity. As a result, oil's domination of the electricity generation energy mix has been significantly reduced and replaced with gas and coal. In 2001, the Five-Fuel Diversification Policy was introduced to incorporate renewable energy as the fifth fuel after oil, gas, coal and hydro.

To diversify fuel use in non-power sectors, particularly the transportation sector, the National Biofuel Policy was introduced in 2006. The policy promotes the production of biofuel by the blending of processed palm oil (5%) with petroleum diesel (95%), it promotes biofuel consumption by establishing biodiesel pumps at selected stations, it ensures biodiesel quality by establishing an industry standard, and it encourages production by encouraging the establishment of biodiesel plants (MPICM, 2006).

At the 2009 Climate Change Summit in Copenhagen, Malaysia's Prime Minister pledged to "voluntarily reduce CO<sub>2</sub> emission intensity of GDP up to 40% by 2020 as compared to 2005 levels, conditional on financial and technological assistance from developed countries". Subsequently, the National Green Technology Policy was formulated, based on four pillars:

1. To attain energy independence and promote efficient utilization
2. To conserve and minimize environmental impacts
3. To enhance economic development through the use of green technology
4. To improve quality of life for all.

Four focus sectors were chosen—energy, buildings, waste and waste management, and transportation. As at mid 2012, several key initiatives have been introduced under the National Green Technology Policy. Government initiatives include the restructuring of the Malaysian Green Technology Corporation, the organization of the annual International Greentech and Eco Products Exhibition and Conference Malaysia (IGEM), the development of Putrajaya and Cyberjaya as pioneer townships in Green Technology, and establishing the Green Technology Fund Scheme (GFTS) which

provides MYR 1.5 billion (USD 490 million) for green technology schemes.

The Malaysia Green Labelling Program (MGLP) has also been introduced—this includes the National Eco Labelling Program to certify eco-friendly domestically manufactured products, and the Energy Star Rating certification for energy-efficient home appliances. To promote green technology in the building sector, the Green Building Index (GBI) has been developed. To obtain a GBI certificate, the developer must ensure that the building meets six criteria: energy efficiency, indoor environmental quality, sustainable site planning and management, use of sustainable materials and resources, water efficiency, and innovation.

The National Renewable Energy Policy and Action Plan came into being in 2010. Its aim is to spur utilization of indigenous renewable energy resources to contribute towards Malaysia's electricity supply security and sustainable socio-economic development. Under this policy, two crucial Acts were established: the Renewable Energy Act 2011 and the Sustainable Energy Development Authority Act 2011, which together set up the framework for the new feed-in tariff mechanism.

The current five-year Malaysian plan, the Tenth Malaysian Plan 2011–2015, and its New Energy Policy aim to address several key issues to ensure economic efficiency and security of supply while still meeting social and environmental objectives.

One crucial issue is rationalizing fuel subsidies. Subsidies represent a substantial financial burden to the Malaysian Government. For instance, in 2009, fuel subsidies alone amounted to MYR 6.2 billion (USD 2 billion), which is almost 4% of government operating expenditure (MOF, 2011). Realizing that subsidies are unsustainable and may lead to sub-optimal resource allocation, as well as negatively impact market efficiency and impede long-term growth potential, the Malaysian Government has started taking steps to restructure subsidy allocations. Under the New Energy Policy, the price of gas to the power sector will be gradually raised by MYR 3 (USD 0.98) per million British thermal units every six months, eventually reaching the market price by 2016. At the same time, subsidy amounts will be itemized in consumer utility bills to increase awareness and encourage efficient energy use. Vehicle fuel subsidies remain unchanged.

The New Energy Policy addresses the energy security issue by developing alternative resources, with emphasis on renewable and clean carbon technology for the power generation sector, and biofuels for the transportation sector. Existing



measures that encourage efficient use of energy, such as the Malaysia Green Labelling Program (MGLP) and Green Building Index (GBI) initiatives, will be extended and further enhanced under the New Energy Policy.

In Malaysia, the government-owned company Petronas holds exclusive ownership rights to all oil and gas exploration and production projects, and all foreign and private companies must operate through production sharing contracts (PSC). In terms of electricity production, the industry is dominated by three integrated utilities: Tenaga Nasional Berhad (TNB) serving Peninsular Malaysia, Sabah Electricity Berhad (SESB) in Sabah state and Sarawak Energy Berhad (SEB) in Sarawak state. TNB is publicly listed while SESB and SEB are privately owned, with the government owning some shares in each utility. The three utilities are complemented by various independent power producers (IPPs), dedicated power producers and co-generators. Under the New Energy Policy, both the gas and electricity sectors are slated for restructuring to raise productivity and improve business efficiency.

At the same time, under the Economic Transformation Programme (ETP), Malaysia has outlined 12 Entry Point Projects (EPPs) for the oil, gas and energy industries. The 12 EPPs are categorized under four main thrusts:

1. *Sustaining oil and gas production.* This involves extending the lifecycle of existing resources by optimizing exploration, development and production activities.
2. *Enhancing downstream growth.* The two EPPs under this thrust involve building a regional oil storage and trading hub, and unlocking gas demand in Peninsular Malaysia by providing better access to gas (through LNG imports and PGU infrastructure), thus encouraging industrial users to switch from diesel to competitively priced natural gas.
3. *Making Malaysia the number one Asian hub for oilfield services.* This thrust leverages on the economy's strategic location, to attract global operations and to build strategic partnerships and joint ventures for developing engineering, procurement and installation capabilities.
4. *Building a sustainable energy platform for growth.* The four EPPs under this thrust are designed to ensure energy security by improving energy efficiency and diversifying energy resources. This includes building up solar power capacity and tapping into Malaysia's hydroelectricity potential.

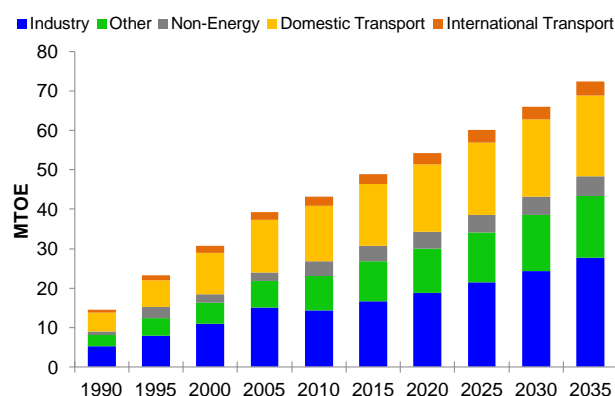
Deploying nuclear energy for electricity generation was one of the EPPs introduced under ETP, but after the Fukushima Nuclear Accident in May 2011, there has been growing public concern regarding the safety and increasing cost of nuclear power development. As of October 2012, the government has yet to decide on the construction of a nuclear power plant or its proposed location (The Star, 2012).

## BUSINESS-AS-USUAL OUTLOOK

### FINAL ENERGY DEMAND

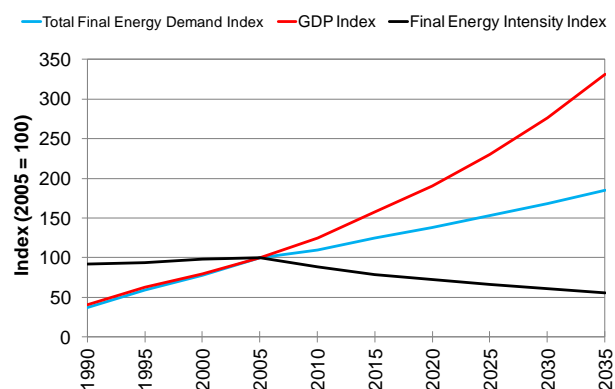
Malaysia's final energy demand (excluding the international transport sector) is projected to grow at an average annual rate of 2.1%, reaching 69 Mtoe by 2035 under business-as-usual (BAU) assumptions. The industry sector accounts for the largest portion with a share of 38% by 2035, followed by the domestic transport sector at 28%. Malaysia's final energy intensity is projected to decline by 44% between 2005 and 2035.

Figure MAS2: BAU Final Energy Demand



Source: APERC Analysis (2012)  
Historical Data: World Energy Statistics 2011 © OECD/IEA 2011

Figure MAS3: BAU Final Energy Intensity



Source: APERC Analysis (2012)

### Industry

By 2035, natural gas will account for the largest share of the final industry demand (33%), followed by electricity and oil, at 28% each. The final energy demand for the industrial sector is expected to nearly double over the outlook period, reaching 28 Mtoe in 2035. The energy intensity for the industrial sector, calculated as industrial demand divided by current GDP, is expected to reduce by 28% within the same time period. This reflects the sector’s shift towards a structure that is less energy intensive as well as improvements in technical energy efficiency.

### Transport

The transport sector energy demand is projected to increase in the outlook period by an average annual rate of 1.5% for domestic transport and 1.8% for international transport, reaching a total of 24 Mtoe in 2035. Petroleum products are expected to remain the dominant transport energy source, but other energy resources, especially natural gas and biofuels, are expected to contribute an increasing share over the outlook period, together accounting for about 3% of the total transport final energy demand in 2035. This would be in line with existing government incentives to encourage utilization of natural gas and biofuel in light vehicles. Currently, the fuelling stations for non-petroleum products are very limited and concentrated mostly within the Klang Valley. The contribution from natural gas would likely increase dramatically if the fuelling stations were more widespread across the economy.

### Other

The final energy demand for the ‘other’ sector, which includes commercial, residential, and agriculture sub-sectors, is projected to grow at an average annual rate of 2.4%, reaching 16 Mtoe in 2035. Electricity constitutes the largest portion, with a share of about 62% (10 Mtoe) in 2035. This will be heavily driven by the need for space cooling. Generally, most urban dwellings are currently equipped with at least basic electrical home appliances such as televisions and refrigerators. Air conditioning is less common outside cities and townships as fans are deemed sufficient to cope with the humid weather. This moderate growth trend will likely continue throughout the outlook period unless there is a drastic change in climate.

### PRIMARY ENERGY SUPPLY

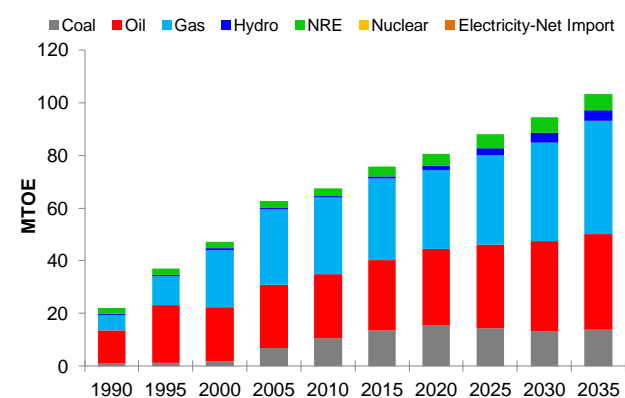
This outlook projects that Malaysia’s primary energy supply will increase significantly from 66 Mtoe in 2009 to over 100 Mtoe in 2035, at an annual average rate of 1.7%. Fossil fuels will account for most of the primary energy supply in 2035, with oil at 35% and gas 42%.

In the medium term, it is expected that the economy will be able to sustain its oil production through the government’s initiative under ETP to rejuvenate existing oilfields and explore new fields like the Kikeh deepwater field. However, given the economy’s maturing oil reserves and the technical and economic issues involved in developing deepwater oilfields, it is likely that production will begin to decline and Malaysia will be a net oil importer by 2025.

Intensified exploration of natural gas fields under ETP has had some success: several new fields have been discovered including Block H off the coast of Sabah (MOC, 2012) and Block SK316 off the coast of Sarawak (Petronas, 2012a). This will lead to increased gas production in the mid-term, and consistent production up to 2030, after which production may begin to decline.

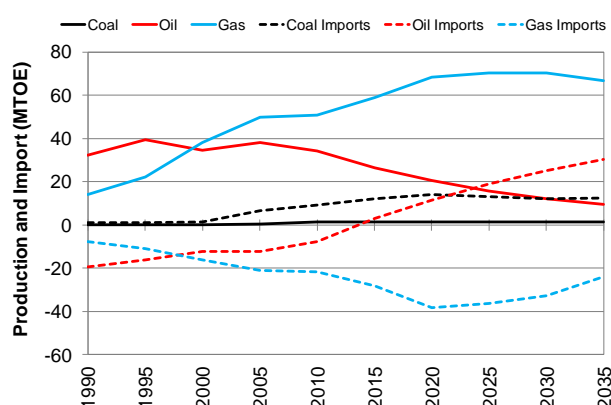
Coal production will remain minimal throughout the outlook period. Coal is mostly consumed by the electricity generation sector, and coal imports are expected to fluctuate according to the addition and retirement of coal power generation capacity throughout the period.

Figure MAS4: BAU Primary Energy Supply



Source: APERC Analysis (2012)  
 Historical Data: World Energy Statistics 2011 © OECD/IEA 2011

Figure MAS5: BAU Energy Production and Net Imports



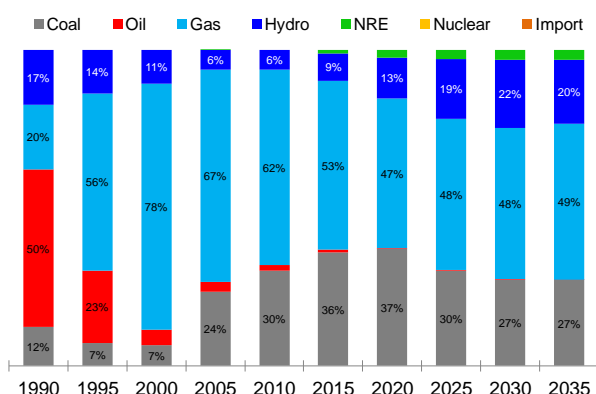
Source: APERC Analysis (2012)  
Historical Data: World Energy Statistics 2011 © OECD/IEA 2011

**ELECTRICITY**

Electricity generation in Malaysia is projected to grow over the outlook period at an average annual rate of 2.8%, doubling from 105.1 TWh in 2009 to 217 TWh in 2035. A key goal for the economy is to create a more balanced generation mix. In order to achieve this, natural gas dependence will be reduced from 62% in 2010 to 49% in 2035. The reduced natural gas share will be taken up by hydro and new renewable energy (NRE).

Hydroelectric generation is projected to grow strongly during the outlook period, based on the development of large hydro projects in Sarawak under the SCORE initiative. NRE, mostly from biomass and solar sources, will also continue to grow from its currently negligible contribution to over 6 TWh in 2035 with the implementation of the feed-in tariff mechanisms.

Figure MAS6: BAU Electricity Generation Mix



Source: APERC Analysis (2012)  
Historical Data: World Energy Statistics 2011 © OECD/IEA 2011

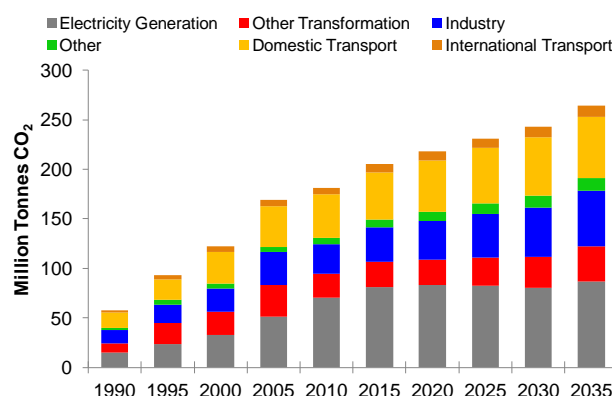
**CO<sub>2</sub> EMISSIONS**

Total CO<sub>2</sub> emissions from fuel combustion are projected to reach 264 million tonnes CO<sub>2</sub> in 2035, which is 46% higher than in 2010 and 360% higher than in 1990. By 2035, the biggest source of CO<sub>2</sub> emissions is the electricity generation sector (33%), followed by the domestic transport sector (24%) and the industry sector (21%).

Under BAU assumptions, Malaysia's CO<sub>2</sub> emission intensity of GDP will likely show a reduction of 32% from 2005 to 2020, compared to the goal set by the government to reduce CO<sub>2</sub> emission intensity of GDP by 40% in the same period. Further efforts are recommended to improve the economy's environmental sustainability, particularly in the power generation, transport and industry sectors.

The decomposition analysis in Table MAS1 indicates that prior to 2005 the total change in CO<sub>2</sub> emissions from fuel combustion was driven by change in GDP. From 2010 onwards, GDP impact on emissions will be offset by the decreasing energy intensity from energy efficiency measures in industrial structure.

Figure MAS7: BAU CO<sub>2</sub> Emissions by Sector



Source: APERC Analysis (2012)

Table MAS1: Analysis of Reasons for Change in BAU CO<sub>2</sub> Emissions from Fuel Combustion

	(Average Annual Percent Change)				
	1990-2005	2005-2010	2005-2030	2005-2035	2010-2035
Change in CO <sub>2</sub> Intensity of Energy	0.2%	-0.2%	-0.2%	-0.2%	-0.2%
Change in Energy Intensity of GDP	0.9%	-2.8%	-2.4%	-2.3%	-2.2%
Change in GDP	6.3%	4.5%	4.1%	4.1%	4.0%
<b>Total Change</b>	<b>7.5%</b>	<b>1.4%</b>	<b>1.5%</b>	<b>1.5%</b>	<b>1.5%</b>

Source: APERC Analysis (2012)

## CHALLENGES AND IMPLICATIONS OF BAU

Malaysia has achieved remarkable success in its economic development agenda, which is strongly underpinned by its energy sector, especially its oil and gas production. Malaysia's oil and gas reserves are modest in size and are gradually depleting. While efforts to discover and exploit new reserves are ongoing and have yielded encouraging success, Malaysia continues to transform its economic portfolio by strategically developing its strengths in sectors other than oil and gas — priority areas include financial services, wholesale and retail, palm oil and rubber production and processing, tourism, electrical and electronics manufacturing, business services, agriculture and healthcare.

In order to ensure long-term energy security, the economy is implementing new, long-term solutions for its energy needs. This includes intensifying energy efficiency initiatives to ensure more productive and prudent use of the remaining reserves, and enhancing efforts to develop viable new renewable energy resources, such as solar, wind, and biofuel. These efforts would also mitigate environmental ill effects caused by the energy sector, especially from the projected 46% increase in total carbon emissions over the outlook period.

## ALTERNATIVE SCENARIOS

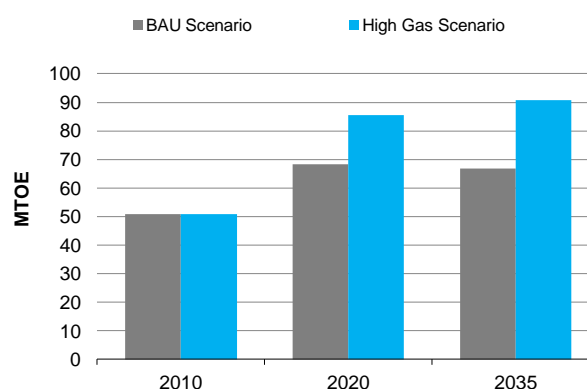
To address the energy security, economic development, and environmental sustainability challenges posed by the business-as-usual (BAU) outcomes, three sets of alternative scenarios were developed for most APEC economies.

### HIGH GAS SCENARIO

To understand the impacts higher gas production might have on the energy sector, an alternative 'High Gas Scenario' was developed. The assumptions behind this scenario are discussed in more detail in Volume 1, Chapter 12. The scenario was built around estimates of gas production that might be available at BAU prices or below, if constraints on gas production and trade could be reduced.

The High Gas Scenario for Malaysia assumed the production increase shown in Figure MAS8, which is 36% by 2035. Two key assumptions were made in this scenario. First, a slight relaxation of the 3% restriction on gas production set under the National Depletion Policy 1980 to 4%. Second, successful commercialization of new natural gas discoveries—this includes Block SB303 in offshore Sabah (Lundin, 2012). These very recent gas discoveries were not included in the BAU assumptions.

Figure MAS8: High Gas Scenario – Gas Production



Source: APERC Analysis (2012)

Additional gas consumption in each economy in the High Gas Scenario will depend not only on the economy's own additional gas production, but also on the gas market situation in the APEC region. The Malaysian Government aims to have a balanced electricity generation mix to avoid dependency on a single fuel. Figure MAS6 shows natural gas already occupies a large portion (62% in 2010) of the generation mix. In line with Malaysia's policies, this alternative scenario assumes that in a high gas availability situation the economy would seek to maximize economic benefits by exporting the additional gas via its LNG and pipeline facilities, rather than increasing natural gas utilization in the power sector. For this reason, Figures MAS9 and MAS10 (which show changes in electricity generation and the resulting change in emissions) were not included.

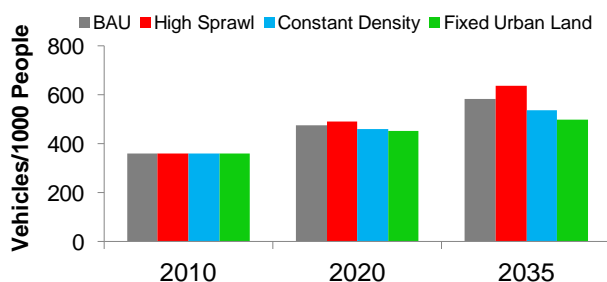
### ALTERNATIVE URBAN DEVELOPMENT SCENARIOS

To understand the impacts of future urban development on the energy sector, three alternative urban development scenarios were developed: 'High Sprawl', 'Constant Density', and 'Fixed Urban Land'. The assumptions behind these scenarios are discussed in Volume 1, Chapter 5.

Figure MAS11 shows the change in vehicle ownership under BAU and the three alternative urban development scenarios. By 2035, the difference between the scenarios is significant, with vehicle ownership being about 9% higher in the High Sprawl scenario compared to BAU, and about 8% lower in the Constant Density scenario and 14% lower in the Fixed Urban Land scenario.



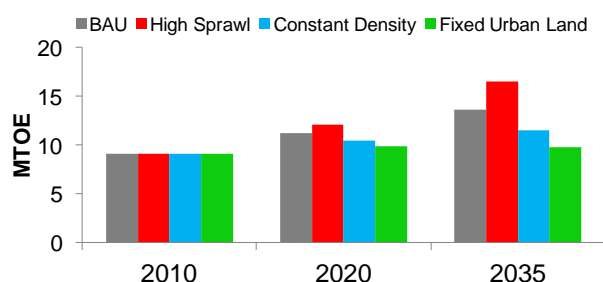
**Figure MAS11: Urban Development Scenarios – Vehicle Ownership**



Source: APERC Analysis (2012)

Figure MAS12 shows the change in light vehicle oil consumption under BAU and the three alternative urban development scenarios. Better urban planning has an even more pronounced impact on light vehicle oil consumption than on vehicle ownership because compact cities reduce both the need for vehicles and the distances they must travel. Light vehicle oil consumption would be 21% higher in the High Sprawl scenario compared to BAU in 2035, and about 16% and 28% lower in the Constant Density and Fixed Urban Land scenarios, respectively.

**Figure MAS12: Urban Development Scenarios – Light Vehicle Oil Consumption**

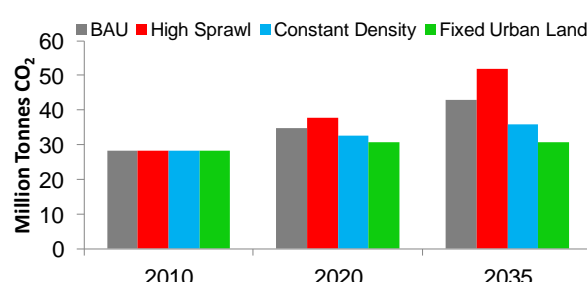


Source: APERC Analysis (2012)

Figure MAS13 shows the change in light vehicle CO<sub>2</sub> emissions under BAU and the three alternative urban development scenarios. The impact of urban planning on CO<sub>2</sub> emissions is similar to the impact of urban planning on energy use, since there is no significant change in the mix of fuels used under any of these scenarios.

The benefits of urban planning in reducing the number of vehicles, oil consumption and CO<sub>2</sub> emissions are quite significant, and Malaysia as a developing economy would do well to incorporate energy saving urban designs in their city planning policies.

**Figure MAS13: Urban Development Scenarios – Light Vehicle Tank-to-Wheel CO<sub>2</sub> Emissions**



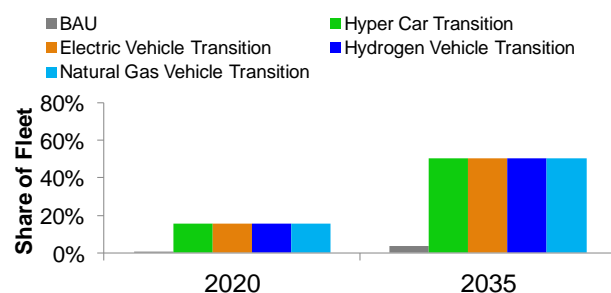
Source: APERC Analysis (2012)

**VIRTUAL CLEAN CAR RACE**

To understand the impacts of vehicle technology on the energy sector, four alternative vehicle scenarios were developed: ‘Hyper Car Transition’ (ultra-light conventionally-powered vehicles), ‘Electric Vehicle Transition’, ‘Hydrogen Vehicle Transition’, and ‘Natural Gas Vehicle Transition’. The assumptions behind these scenarios are discussed in Volume 1, Chapter 5.

Figure MAS14 shows the evolution of the vehicle fleet under BAU and the four ‘Virtual Clean Car Race’ scenarios. By 2035 the share of the alternative vehicles in the fleet reaches around 50% compared to about 4% in BAU. The share of conventional vehicles in the fleet is thus only about 50%, compared to about 96% in the BAU scenario.

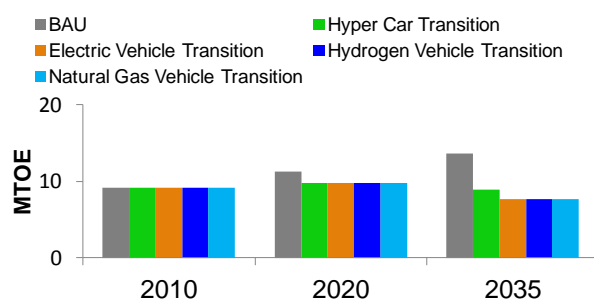
**Figure MAS14: Virtual Clean Car Race – Share of Alternative Vehicles in the Light Vehicle Fleet**



Source: APERC Analysis (2012)

Figure MAS15 shows the change in light vehicle oil consumption under BAU and the four alternative vehicle scenarios. Oil consumption drops by 44% in the Electric Vehicle Transition, Hydrogen Vehicle Transition, and Natural Gas Vehicle Transition scenarios compared to BAU in 2035. The drop is large as these alternative vehicles use no oil. Oil demand in the Hyper Car Transition scenario is also significantly reduced compared to BAU: down 27% by 2035—even though these highly efficient vehicles still use oil.

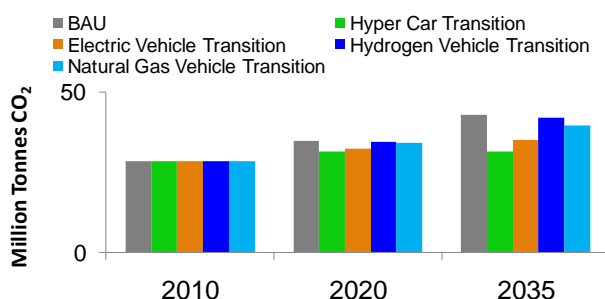
**Figure MAS15: Virtual Clean Car Race – Light Vehicle Oil Consumption**



Source: APERC Analysis (2012)

Figure MAS16 shows the change in light vehicle CO<sub>2</sub> emissions under BAU and the four alternative vehicle scenarios. To allow for consistent comparisons, in the Electric Vehicle Transition and Hydrogen Vehicle Transition scenarios, the change in CO<sub>2</sub> emissions is defined as the change in emissions from electricity and hydrogen generation. The impact of each scenario on emission levels may differ significantly from its impact on oil consumption, since each alternative vehicle type uses a different fuel with a different level of emissions per unit of energy.

**Figure MAS16: Virtual Clean Car Race – Light Vehicle CO<sub>2</sub> Emissions**



Source: APERC Analysis (2012)

In Malaysia, the Hyper Car Transition scenario is the clear winner in terms of CO<sub>2</sub> emission reduction, with an emission reduction of 27% compared to BAU in 2035. The Electric Vehicle Transition scenario would be second, offering a reduction of 18% compared to BAU in 2035. The Natural Gas Vehicle Transition and Hydrogen Vehicle Transition scenarios offer lower emission reductions (8% and 2% respectively).

Hyper cars rely on their ultra-light carbon fibre bodies and other energy-saving features to reduce oil consumption, while in the other alternative vehicles oil combustion is replaced by other fuels—namely electricity for electric vehicles, hydrogen for hydrogen vehicles and gas in natural gas vehicles. Thus, additional demand for electricity and hydrogen generation would produce more CO<sub>2</sub> emissions and

this will offset some of the benefits gained from oil replacement. However, since Malaysia's electricity generation relies heavily on natural gas, electric vehicles tend to do better in terms of CO<sub>2</sub> emissions than they do in other economies that rely more on higher-emitting coal for electricity generation.

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